

# Next Generation Distribution System Platform (DSPx)

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# DSPx Project Overview

## Origin:

Initiated by CA and NY, plus DC, HI & MN commissions, in late-2015 to examine what is needed to develop a next-generation distribution system platform (DSPx)

## Objective:

Provide guidance to facilitate a grid modernization decision process that can better align the expectations of regulators, utilities and technology developers

## Approach:

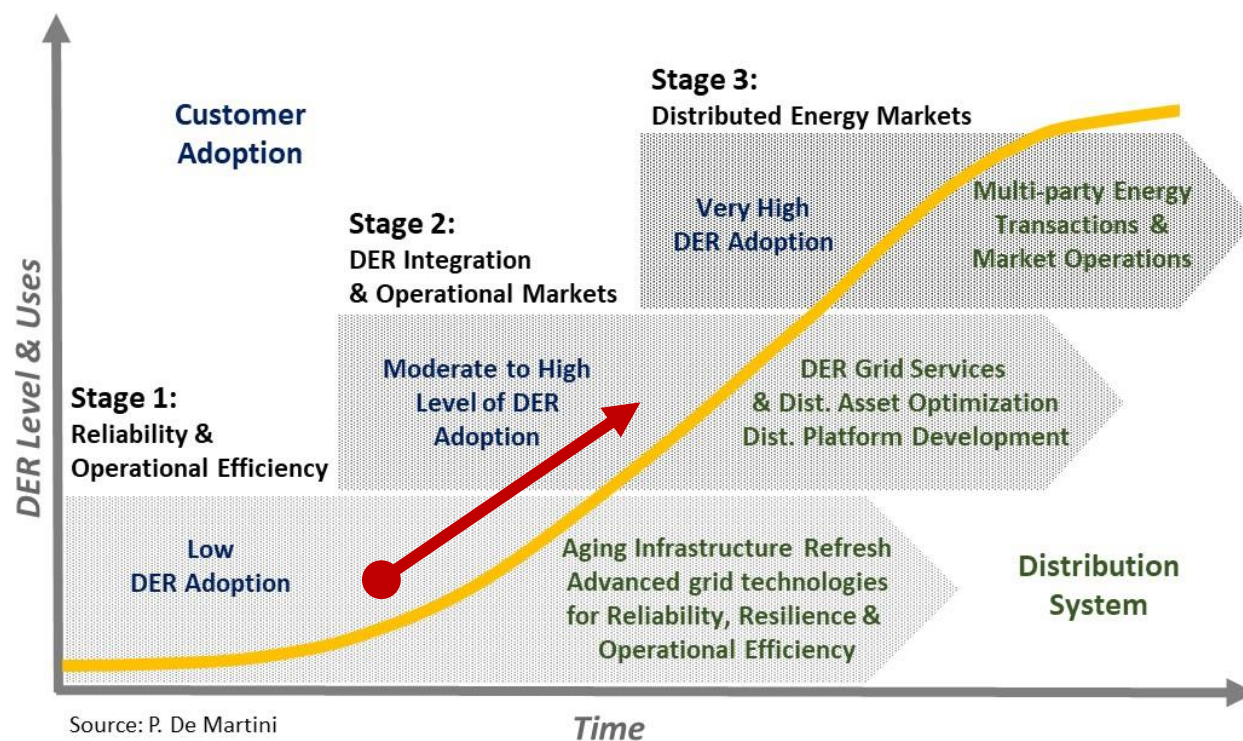
With direction provided from a Steering Committee representing the commissions, engage key stakeholders to develop functional requirements, assess the maturity of technology, and articulate key considerations for the staged deployment of advanced grid capabilities

Apply DOE-developed grid architecture principles to impart a holistic, organized, and coordinated approach to grid planning and design (beginning with objectives)

Provide unbiased and expert technical assistance during this formative period of grid transition (especially valuable to regulators needing to consider options in a neutral manner)

# Distribution Grid Evolution

US distribution systems currently have Stage 1 functionality - a key issue is whether and how fast to transition into Stage 2 functionality



# Modern Distribution Grid Report

## A rigorous approach to support development of grid modernization strategies and implementation plans based on best practices

- ▶ **Volume I: Maps Grid Modernization Functionality to Objectives**
  - Grid architectural approach that maps grid modernization functionality to state objectives within a planning, grid operations & market operations framework
    - **Enables evaluation of functionality required to meet a specific objective**
- ▶ **Volume II: Assessment of Grid Technology Maturity**
  - Assessment of the readiness of advanced grid technology for implementation to enable functionality and objectives identified in Volume I.
    - **Enables evaluation of technology readiness for implementation**
- ▶ **Volume III: Implementation Decision Guide**
  - Decision criteria and considerations related to developing a grid modernization strategy and implementation roadmap with examples to illustrate application
    - **Enables development & evaluation of grid modernization strategies and roadmaps for implementation**

# Architecture Manages Complexity

**Issues with the scale and scope of dynamic resources envisioned in policy objectives for grid modernization requires a holistic architectural approach**



So, pick-up a pencil



Before trying to  
hang windows



# Distribution Platform Capabilities

## Capabilities derived from state policy objectives

Objectives	CA	DC	FL	HI	IL	MA	MN	NC	NY	OR	TX
Affordability	●	●	●	●	●	●	●	●	●	●	●
Reliability	●	●	●	●	●	●	●	●	●	●	●
Customer Enablement	●	●	●	●	●	●	●	●	●	●	●
System Efficiency	●	●	●	●	●	●	●	●	●	●	●
Enable DER Integration	●	●	●	●	●	●	●		●	●	●
Adopt Clean Technologies	●	●	●	●	●	●		●	●	●	●
Reduce Carbon Emissions	●	●	●	●				●	●	●	●
Operational Market Animation	●	●		●			●		●		

From DSPx Volume 1 – Customer and State Policy Driven Functionality, version 1.1, March 23, 2017

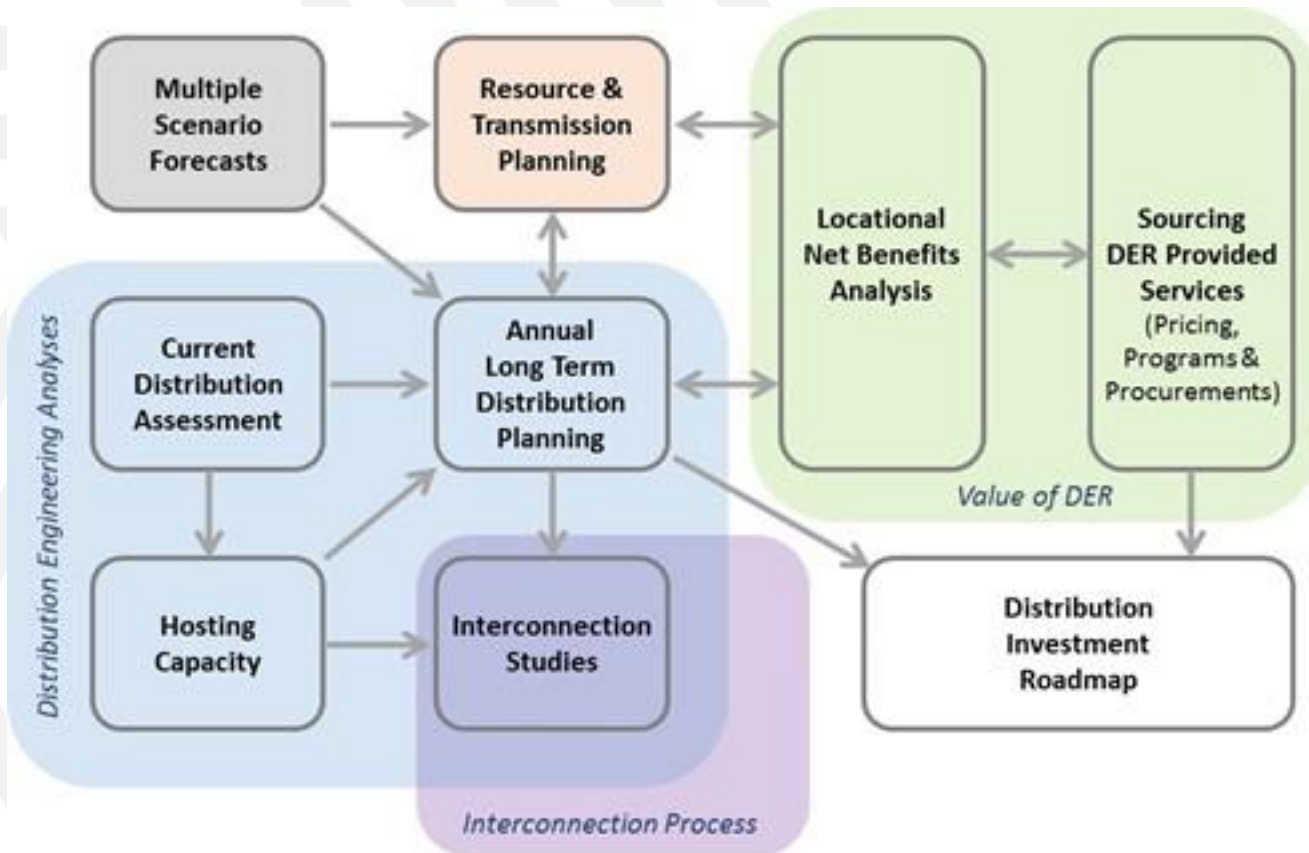
● New  
● Existing

Functions		Reliability, Safety & Operational Efficiency	DER Integration	DER Utilization
	Market Operations	<div></div>	<div></div>	<div></div>
	Grid Operations	<div></div>	<div></div>	<div></div>
	Planning	<div></div>	<div></div>	<div></div>



## Integrated Planning Considerations

**Integrated planning and analysis needed within and across the transmission, distribution and customer/3<sup>rd</sup> party domains**



# Grid as a Platform



- Grid as Back-up to customer self-sufficiency erodes grid value for all customers
- Business as usual enhances value through aging infrastructure replacement and operational efficiencies
- **Grid as Platform expands value through enabling DER integration at scale and utilization as a system and grid resource**
- Convergence model extends value through synergies between electric service and other essential networks such as water, telecom and transportation, often pursued in smart city initiatives



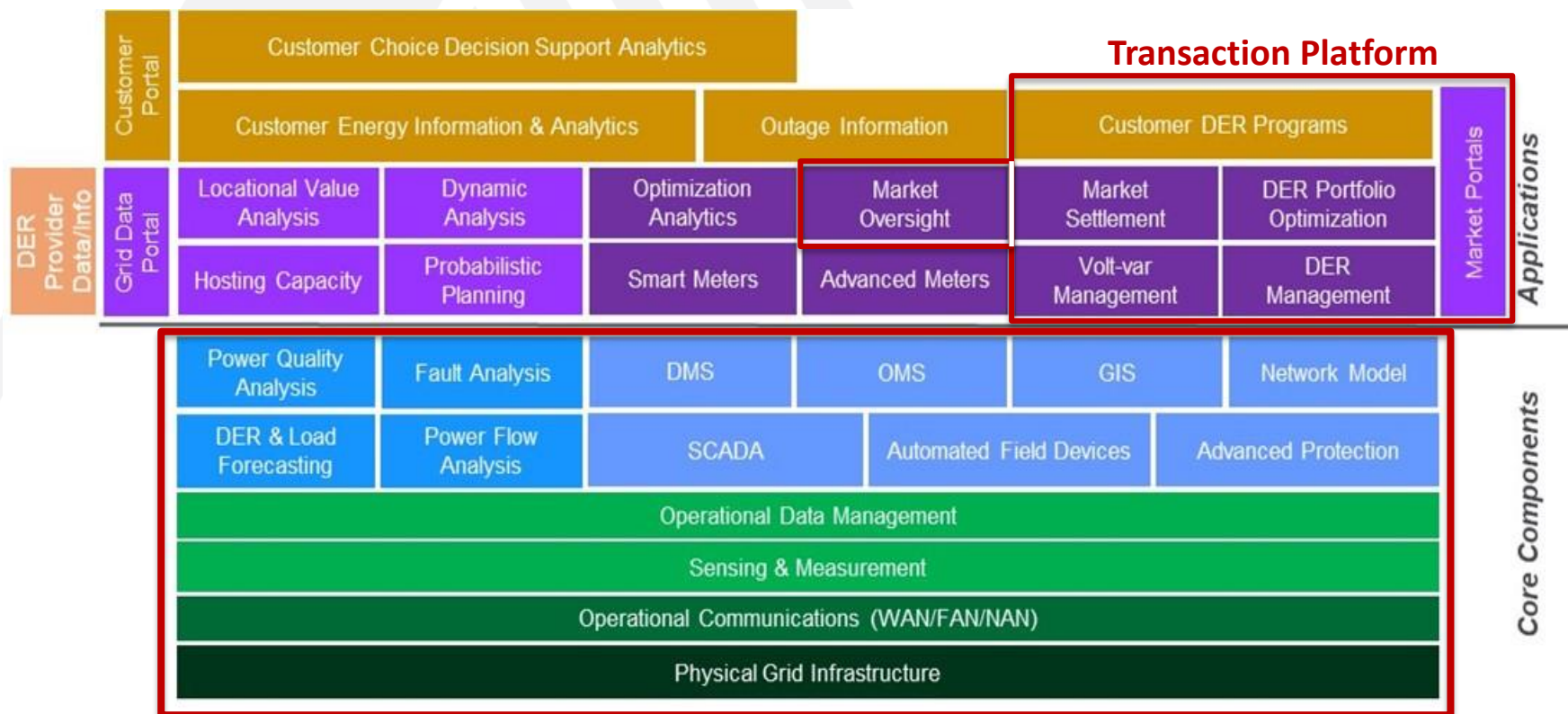
# Grid as a Platform

- ▶ A ***cyber-physical grid platform*** involves certain components that remain relatively stable forming the *core platform*, while other complementary modules are integrated over time through interoperable interfaces.
- ▶ The cyber-physical grid platform must exist even if only to provide traditional electric service, and must be modernized if higher DER presence is anticipated, irrespective of whether any given state jurisdiction decides to adopt a market or transactional platform.
- ▶ A ***transaction platform*** facilitates one-to-many markets, such as the use of DERs to provide grid services to a distribution operator or multi-sided markets, such as those which may occur in the future

***A modern distribution grid involves the development of a cyber-physical infrastructure platform, while other related modules enable the creation of a distribution operational market transaction platform.***

# Platform Considerations

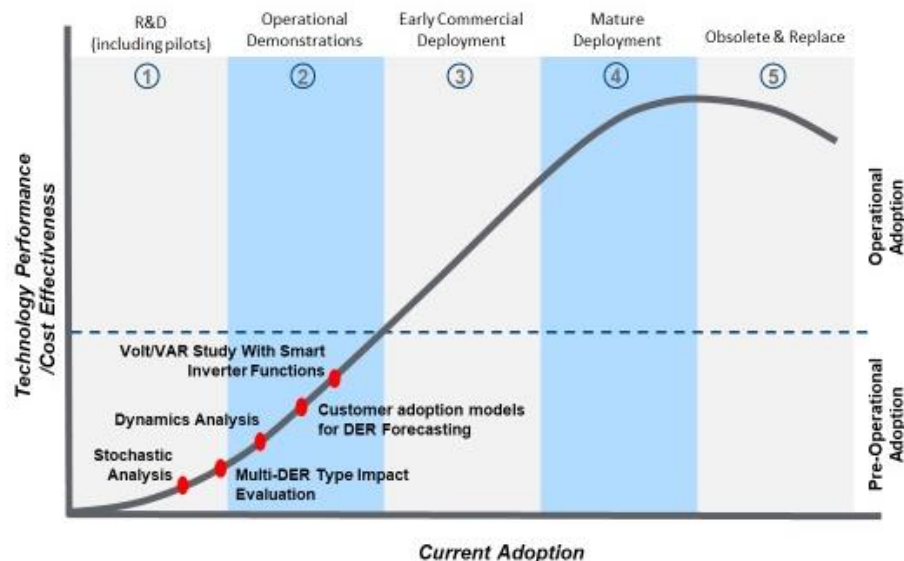
Core components are foundational; applications layer on this foundation as additional functionality is needed



Source: DOE, Modern Distribution Grid, Volume 3

**Cyber-Physical Grid Platform**

# Technology Maturity

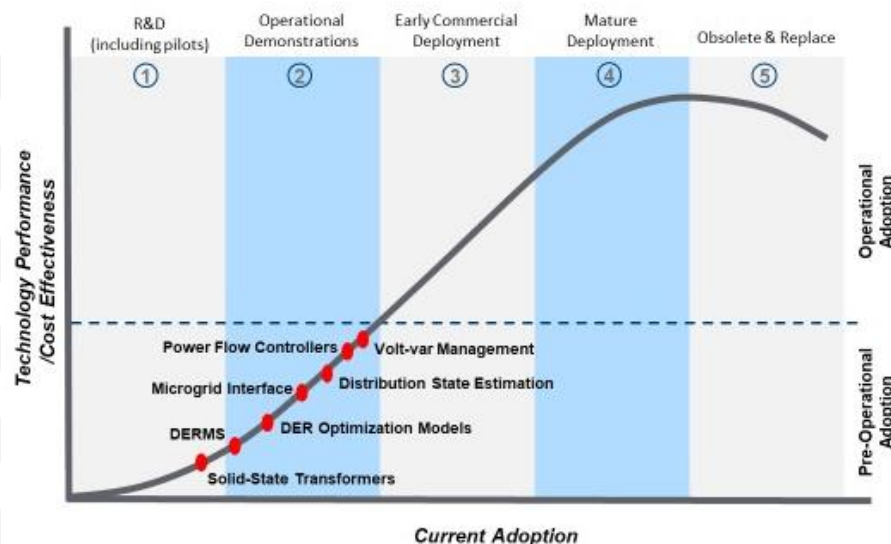


## Grid Planning

Primary gaps exist in modeling customer DER adoption, multi-type DER behavior impacts and resulting random variability on distribution circuits necessary in high/very high DER systems

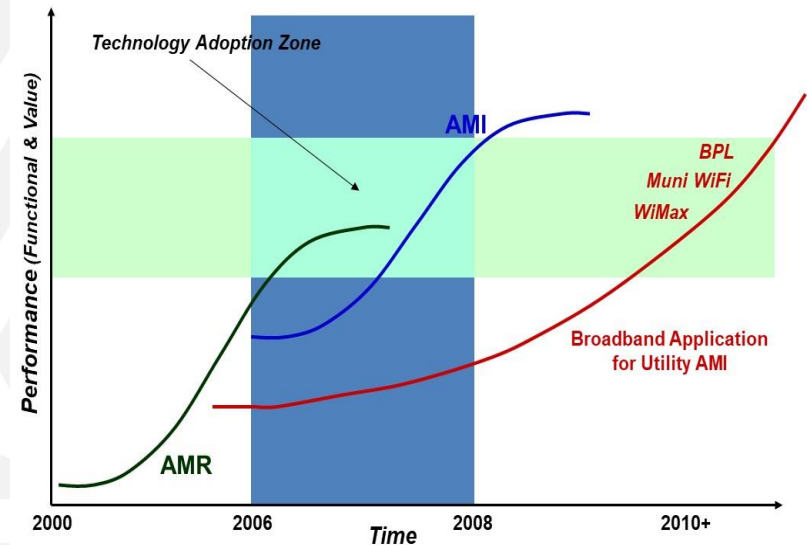
## Grid Operations

Primary gaps exist in DER control & optimization systems, distribution state estimation models and needed grid power electronics to address operational dynamics



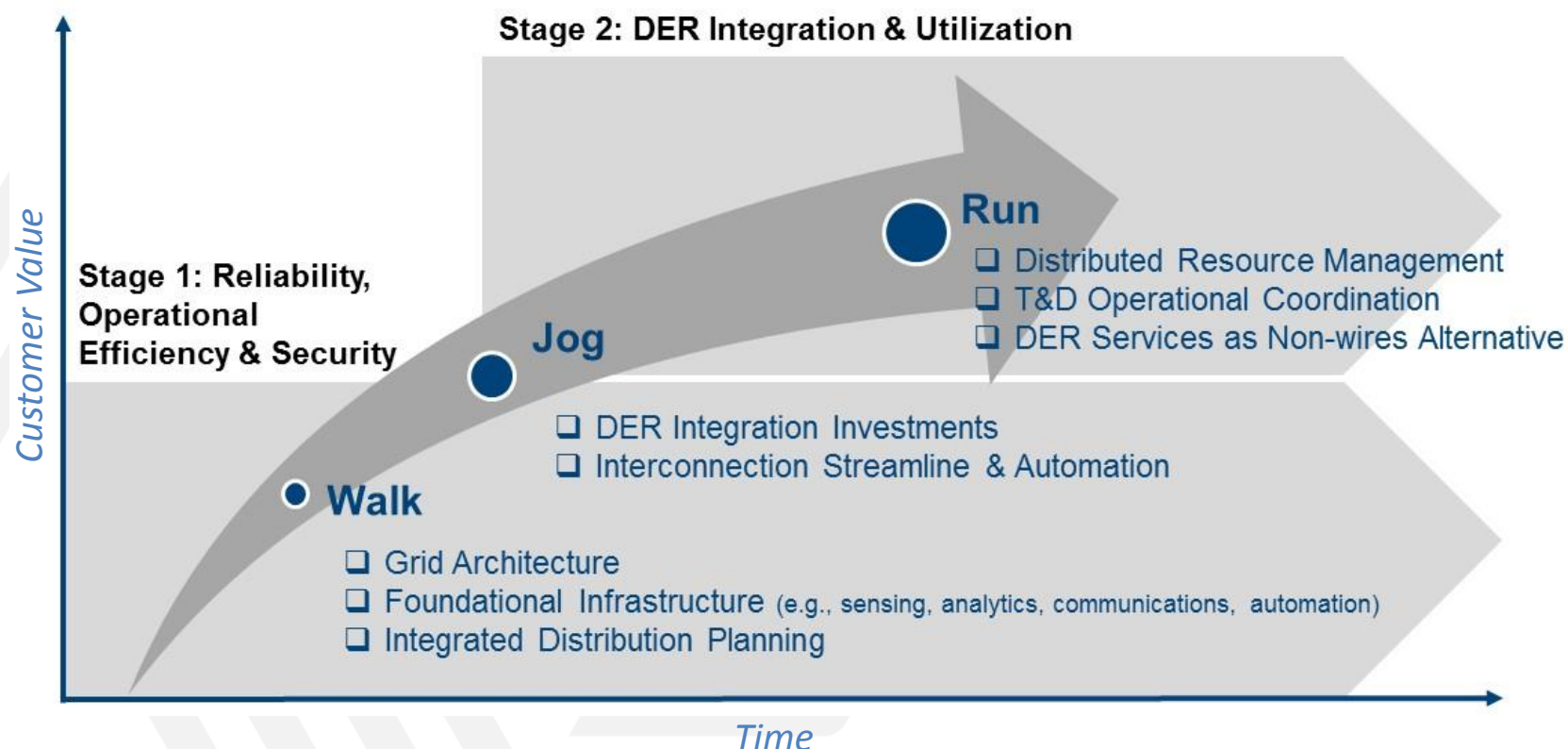
# Technology Evolution & Obsolescence Risk

- ▶ Where is a technology in its life-cycle (S-curve)?
- ▶ What emerging technologies may be substitutes?
- ▶ Type of technology obsolescence matters
  - ☐ Functional
  - ☐ Technical
- ▶ Mitigation strategies exist
  - ☐ Interoperability
  - ☐ Backward compatibility
  - ☐ Shorter depreciation periods



# Timing & Pace Considerations

**Pace & scope of investments are driven by customer needs & policy objectives.**  
**Proportional deployment to align with customer value**



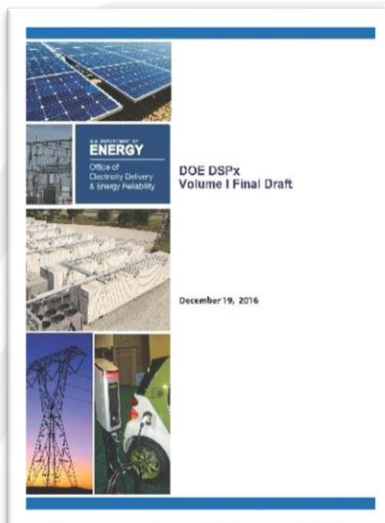
# Findings

- Regulatory commissions are very interested in developing appropriate (“low-regrets”) grid modernization strategies especially where policies have encouraged rapid adoption of DERs
- Planning the effective transition from legacy to advanced, digital systems is challenging:
  - Mismatch in technology life-cycles and institutional planning cycle times
  - Difficulty in forecasting DER adoption and assessing mixed DER options
  - Proportional deployment needed to respect affordability objectives
  - Pace and scope of deploying the sensing, communication and control systems need to be considered
- Grid architecture provides an organizing approach within grid modernization processes
- DSPx is serving as a means to discuss technology strategy and helps to bridge the gap between utilities and regulators in the development of that strategy
- The first phase of DSPx has provided a foundation that can help utilities and commissions develop implementation plans in the near-term (through 2021)



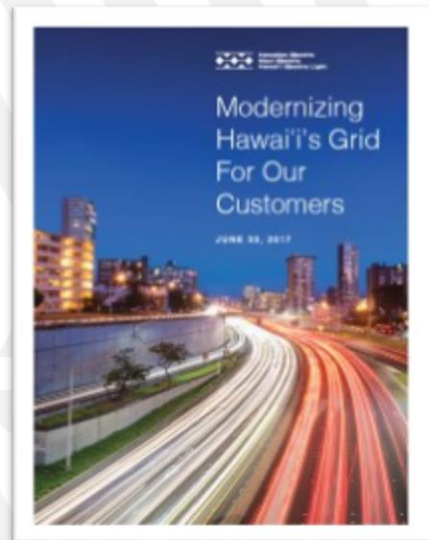
# DSPx References

## Modern Distribution Grid Report



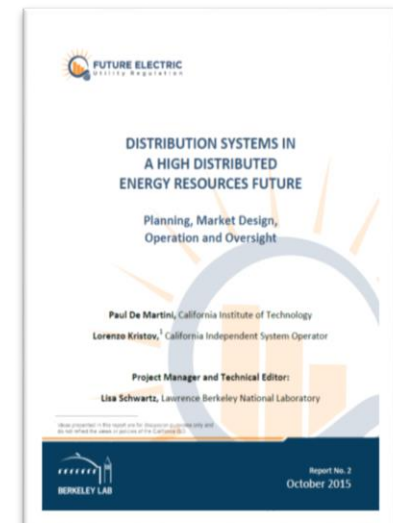
[www.doe-dspx.org](http://www.doe-dspx.org)

## Grid Modernization Strategy Using DSPx



[www.hawaiianelectric.com/  
gridmod](http://www.hawaiianelectric.com/gridmod)

## DSO Paper



<https://emp.lbl.gov/projects/feur>